

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

[illegible]

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(WGEC0055)

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**IN THE CLAIMS:**

Claims 9-11, 16 and 28 were previously cancelled without prejudice. Please now amend the claims as follows:

1. (Previously Presented) A method for determining shallow water flow risk, comprising:

developing a geologic model of shallow water flow risk areas;

performing a stratigraphic analysis on only P-wave seismic data to determine a control location within the P-wave seismic data;

applying a pre-stack full waveform inversion on only the P-wave seismic data at the control location to provide an elastic model, wherein the elastic model comprises P - wave velocity and S-wave velocity;

computing a ratio between the P-wave velocity and the S-wave velocity; and

identifying shallow water flow risk areas using the P-wave velocity to the S -wave velocity ratio.

2. (Original) The method of claim 1, wherein the seismic data comprises seismic data selected from the list consisting of one-dimensional seismic data, two-dimensional seismic data, and three-dimensional seismic data.

3. (Original) The method of claim 1, wherein the elastic model further comprises attributes selected from the list consisting of density, Poisson's ratio, and Lamé elastic parameters.

4. (Original) The method of claim 1, further comprising processing the seismic data to enhance its stratigraphic resolution.

5. (Original) The method of claim 4, wherein the processing the seismic data comprises sub-sampling the seismic data to less than two millisecond intervals.

6. (Original) The method of claim 4, wherein the processing the seismic data comprises using an algorithm with an amplitude preserving flow.

7. (Original) The method of claim 4, wherein the processing the seismic data comprises using an algorithm selected from the list consisting of a pre-stack time migration, accurate velocity normal-moveout correction, and noise removal algorithms.

8. (Original) The method of claim 1, wherein the control location comprises a plurality of control locations.

9. (Cancelled)

10. (Cancelled)

11. (Cancelled)

12. (Currently Amended) The method of claim 1 ~~44~~, wherein performing the stratigraphic analysis comprises identifying the control location by using the geologic model to identify a geologic feature selected from this list consisting of faults, blow-outs,

bioherms, chaotic facies, cones, diapers, domes, gas vents, gas mounds, mud volcanoes, popckmarks, scarps, slumps, channels, slope fan deposition, and bottom simulator reflectors.

13. (Currently Amended) The method of claim 1 9, wherein selecting the control location within the seismic data further comprises evaluating the seismic attributes of the seismic data.

14. (Original) The method of claim 13, wherein evaluating the seismic attributes comprises using amplitude-variation-with-offset attributes, comprising intercept and gradient.

15. (Previously Presented) The method of claim 13, wherein evaluating the seismic attributes comprises evaluating polarity changes in reflection coefficient.

16. (Cancelled)

17. (Original) The method of claim 1, wherein the pre-stack waveform inversion comprises applying a genetic algorithm.

18. (Currently Amended) The method of claim 17 16, wherein the genetic algorithm comprises:

generating a plurality of elastic earth models;

generating pre-stack synthetic seismograms for the elastic earth models;  
matching the generated seismograms with the seismic data;  
generating a fitness for the elastic earth models;  
genetically reproducing the elastic earth models using the fitness for the elastic earth models; and  
determining convergence of the reproduced elastic earth models to select the elastic model.

19. (Original) The method of claim 18, wherein the plurality of elastic earth models comprises a random population of the elastic earth models.

20. (Previously Presented) The method of claim 1, wherein applying the pre-stack full waveform inversion comprises using an exact wave equation having mode conversions and interbed multiple reflections.

21. (Original) The method of claim 18, wherein matching the generated seismograms with a plurality the seismic data further comprises matching normal moveout of the generated seismograms and the seismic data, and matching reflection amplitudes of the generated seismograms and the seismic data.

22. (Original) The method of claim 18, wherein genetically reproducing the elastic earth models using the fitness for the elastic earth models comprises:

reproducing the elastic earth models in proportion to the elastic earth models fitness;

randomly crossing over the reproduced elastic earth models; and

mutating the reproduced elastic earth models.

23. (Original) The method of claim 1, further comprising applying a post-stack inversion on the seismic data using the elastic model to determine the shallow water flow risk over a 3D volume.

24. (Original) The method of claim 1, wherein the post-stack inversion is performed using an AVO intercept and a pseudo shear-wave data volume.

25. (Previously Presented) The method of claim 1, wherein shallow water flow risk is identified when the P-wave velocity compared to the S-wave velocity is between approximately 3.5 and approximately 7.

26. (Currently Amended) A computerized method for determining shallow water flow risk using seismic data comprising:

processing P-wave seismic data to enhance its stratigraphic resolution, wherein the P-wave seismic data are obtained from marine towed streamers hydrophones;

selecting a control location comprising:

performing a stratigraphic analysis on the P-wave seismic data; and

evaluating the seismic attributes of the P-wave seismic data;

applying a pre-stack waveform inversion on the P-wave seismic data at the control location to provide an elastic model, wherein the elastic model comprises P-wave velocity and S-wave velocity;

applying a post-stack inversion on the P-wave seismic data using the elastic model to map a ratio between the P-wave velocity and the S-wave velocity in a three dimensional (3D) volume; and

determining the shallow water flow risk using the ratio between the P-wave velocity and the S-wave velocity in the 3D volume.

27. (Original) The method of claim 26, wherein the pre-stack waveform inversion comprises using a genetic algorithm comprising:

generating a plurality of elastic earth models;

generating pre-stack synthetic seismograms for the elastic earth models;

matching the generated seismograms with the seismic data;

generating a fitness for the elastic earth models;

genetically reproducing the elastic earth models using the fitness for the elastic earth models; and

determining convergence of the reproduced elastic earth models to select the elastic model.

28. (Cancelled)

29. (Previously Presented) A method for determining a shallow water flow risk area, comprising:

developing a geologic model of the shallow water flow risk area;

performing a stratigraphic analysis on only P-wave seismic data to determine a control location within the P-wave seismic data;

applying a pre-stack waveform inversion on the P-wave seismic data at the control location to provide P-wave velocity ( $V_p$ ) and Poisson's ratio;

computing for S-wave velocity ( $V_s$ ) using the P-wave velocity ( $V_p$ ) and the Poisson's ratio;

computing for a ratio between the P-wave velocity ( $V_p$ ) and the S-wave velocity ( $V_s$ ); and

identifying the shallow water flow risk area using the ratio ( $V_p/V_s$ ).

30. (Previously Presented) The method of claim 29, wherein the S-wave velocity ( $V_s$ ) is computed using

$$v = \frac{1 - 2 \left( \frac{V_s}{V_p} \right)^2}{2 \left[ 1 - \left( \frac{V_s}{V_p} \right)^2 \right]}, \text{ where } v \text{ is the Poisson's ratio, } V_p \text{ is the P-wave velocity and } V_s \text{ is the}$$

S-wave velocity.

31. (Previously Presented) The method of claim 1, wherein the P-wave seismic data are a single component P-wave seismic data.



32. (Previously Presented) The method of claim 1, wherein the S-wave velocity is obtained indirectly from an amplitude variation with offset (AVO) analysis of the P-wave seismic data.

## REMARKS

This is intended as a full and complete response to the Final Office Action dated February 3, 2009, having a shortened statutory period for response set to expire on May 3, 2009.

Claims 12-13, 18 and 26 have been amended to change their claim dependencies or to more clearly recite various aspects of the invention. Applicants believe no new matter has been introduced by the amendments presented herein. The amendments have been made to put the claims in condition for allowance or in better condition for an appeal. Please reconsider the claims pending in the application for reasons discussed below.

Applicants would like to thank the Examiner for withdrawing (1) the 102(a) rejection over cited in the Notice of Non-Responsive Reply mailed September 23, 2008 and Office Action mailed February 22, 2008 ("previous Office Action"); and (2) the objections to the drawings raised in the previous Office Action.

Claims 12-15, 18-19 and 21-22 are objected for depending upon cancelled claims. Applicants would like to thank the Examiner for pointing these out. Claims 12-13 have been amended to depend from claim 1. Claim 18 has been amended to depend from claim 17. The amendments to change the dependency in claims 12-13 and 18 were inadvertently overlooked when the base claims from which claims 12-13 and 18 depend were cancelled without prejudice. Withdrawal of the objection is respectfully requested.

Claims 26-27 stand rejected under 35 USC 112, first paragraph. In particular, the Examiner takes the position that the specification does not support "hydrophones" in claim 26 and that it only supports "streamers". Accordingly, claim 26 has been amended to replace "hydrophones" with "streamers". Withdrawal of the rejection is respectfully requested.

Claims 1-8, 17, 20, 23-27 and 29-32 stand rejected under 35 USC 103(a) as being unpatentable over Hybrid Seismic Inversion: A Reconnaissance Tool For Deepwater Exploration, 11/2000 by Mallick et al. (Mallick 2000) in view of US Patent No. 6,694,261 ("Huffman"). Applicants respectfully traverse this rejection.

The Examiner takes the position that column 2 and 3 on page 1230 of Mallick 2000 teaches “developing a geologic model of shallow water flow risk areas; performing a stratigraphic analysis on only P-wave seismic data to determine a control location within the P-wave seismic data.” In particular, the Examiner states the following statements as teaching those limitations:

**The elastic earth models (consisting of P-wave velocity, density, and Poisson's ratio)** obtained at each location of the prospect where **prestack GA inversion** was run can be used as background low-frequency impedance trends for poststack inversion and can create a hybrid inversion scheme.

Nothing in the above statements or in columns 2-3 on page 1230 teaches or discloses performing a stratigraphic analysis on only P-wave seismic data to determine a control location within the P-wave seismic data. In fact, Mallick 2000 mentions nothing about performing any stratigraphic analysis, let alone performing a stratigraphic analysis on only P-wave seismic data.

Further, as the Examiner mentions, Mallick 2000 does not teach or disclose identifying shallow water flow risk areas using the P-wave velocity to the S-wave velocity ratio. However, the Examiner attempts to supplement this missing limitation with Huffman. Nevertheless, like Mallick 2000, Huffman also does not teach or disclose performing a stratigraphic analysis on only P-wave seismic data to determine a control location within the P-wave seismic data. Since neither Mallick 2000 nor Huffman, alone or in combination, teaches or discloses “performing a stratigraphic analysis on only P-wave seismic data to determine a control location within the P-wave seismic data” or “performing a stratigraphic analysis on the P-wave seismic data,” claims 1, 26 and 29 are patentable over Mallick 2000 and Huffman. Claims 2-8, 12-15, 17-25, 27 and 30-32 are also patentable over Mallick 2000 and Huffman, since they depend from claims 1, 26 and 29, respectively. Withdrawal of the rejection is respectfully requested.

In conclusion, the references cited by the Examiner, neither alone nor in combination, teach, show, or suggest the claimed invention. Having addressed all

issues set out in the office action, Applicants respectfully submit that the claims are in condition for allowance and respectfully request that the claims be allowed.

Respectfully submitted,

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